

## PATENT COOPERATION TREATY



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## PCT

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P62031PC00		<b>FOR FURTHER ACTION</b>		See Form PCT/PEA416
International application No. PCT/NL2004/000432		International filing date (day/month/year) 17.06.2004	Priority date (day/month/year) 17.06.2003	
International Patent Classification (IPC) or national classification and IPC H01L51/20				
Applicant NEDERLANDSE ORGANISATIE VOOR TOEGEPAST-... et al.				
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 11 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau a total of 3 sheets, as follows:</p> <p style="margin-left: 40px;"><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p style="margin-left: 40px;"><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>				
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>				
Date of submission of the demand  06.04.2005		Date of completion of this report  22.09.2005		
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016		Authorized Officer  Faou, M  Telephone No. +31 70 340-4992 		

INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITYInternational application No.  
PCT/NL2004/000432

IAP20 Rec'd PCT/PTO 16 DEC 2005

**Box No. I Basis of the report**

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language, which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

**Description, Pages**

1-23 as originally filed

**Claims, Numbers**

1-21 as originally filed

**Drawings, Sheets**

1/7-7/7 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing *(specify)*:
  - ☐ any table(s) related to sequence listing *(specify)*:
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing *(specify)*:
  - ☐ any table(s) related to sequence listing *(specify)*:

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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1. Statement

Novelty (N)	Yes: Claims	1-14,22
	No: Claims	15-21
Inventive step (IS)	Yes: Claims	
	No: Claims	1-22
Industrial applicability (IA)	Yes: Claims	1-22
	No: Claims	

2. Citations and explanations (Rule 70.7):

**see separate sheet**

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**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability;  
citations and explanations supporting such statement**

- D1 : ZHANG CHI ET AL: "Gallium nitride/conjugated polymer hybrid light emitting diodes: Performance and lifetime" JOURNAL OF APPLIED PHYSICS, AMERICAN INSTITUTE OF PHYSICS. NEW YORK, US, vol. 84, no. 3, 1 August 1998, pages 1579-1582
- D2 : US 6 127 693 A (CHANG EN-CHUNG ET AL) 3 October 2000
- D3 : PAIK ET AL: "White light-emitting diodes from novel silicon-based copolymers

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D4a: PATENT ABSTRACTS OF JAPAN vol. 1995, no. 04, 31 May 1995

D4b: JP 7 030148 A (MITSUBISHI CABLE IND LTD), 31 January 1995

(corresponding Japanese patent application of D4a)

D5: US-B-6 331 438 (AYLOTT JONATHAN W ET AL) 18 December 2001

D6: US-A-5 307 146 (PORTER MARC D ET AL) 26 April 1994

The documents D7-D10 were not cited in the international search report.

D7: US-B-6278134 (LUCENT TECHNOLOGY) 21 August 2001

D8: US-B-6235414 (THE OHIO STATE UNIVERSITY RESEARCH FOUNDATION) 22  
May 2001

D9: GB-A-2340304 (CAMBRIDGE DISPLAY TECHNOLOGY) 16 February 2000

D10: EP-A-1286569 (EASTMAN KODAK COMPANY) 26 February 2003



1.

The application does not meet the requirements of Article 6 PCT, because claims 1, 14, 15, 16 and 17 are not clear.

The term "electroluminescent functionalities" used in claims 1, 15, 16 17 is vague and unclear and leaves the reader in doubt as to the meaning of the technical features to which it refers, thereby rendering the definition of the subject-matter of said claim unclear, Article 6 PCT. It is not clear from this definition that the two electroluminescent functionalities refer to the emission of two wavelengths from the active layer.

Claim 14 does not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined. The claim attempts to define the subject-matter in terms of the result to be achieved "light emitting diode, depending on the direction of the electric current, emits light having a first maximum, or light having a second maximum", which merely amounts to a statement of the underlying problem, without providing the technical features essential for achieving this result.

2.

Furthermore, the above-mentioned lack of clarity notwithstanding, the subject-matter of claims 15-21 is not new in the sense of Article 33(2) PCT, and therefore the criteria of Article 33(1) PCT are not met.

2.1

Document D9 describes (the references in parentheses applying to this document):

A light-emitting diode having at least one semiconductive electroluminescent active layer (page 12) which comprises at least two different electroluminescent functionalities (page 12, first paragraph), wherein the emission spectrum of the diode exhibits at least two intensity maxima (figure 14) and wherein the LED comprises an electroluminescent polymer (F6M) and an electroluminescent single dye (perylene).

All features of claim 15 are disclosed in D9, therefore the subject-matter of this claim is not new in the sense of Article 33(2) PCT.

The features of independent claim 16 and method claims 18 and 19 are also disclosed in D9

(see pages 6, 12) (Article 33(2) PCT).

## 2.2

Document D10 describes (the references in parentheses applying to this document):

A light-emitting diode having at least one semiconductive electroluminescent active layer (table 1) which comprises at least two different electroluminescent functionalities (table 1), wherein the emission spectrum of the diode exhibits at least two intensity maxima (figure 8) and wherein the LED comprises a filter (paragraphs 50, 96, 60), which filter selectively has at least a reduced transmission of light of a wavelength between two consecutive maxima (the filter selects one maxima to produce a pure red, green or blue and has a reduced transmission for other wavelengths, therefore at least for wavelengths between two maxima).

All features of claim 17 are disclosed in D10, therefore the subject-matter of this claim is not new (Article 33(2) PCT).

## 2.3

Document D7 discloses the use of a single light source for generating a reference signal and a detection signal in a detection system wherein the  $\lambda_{\max}$  of the reference signal differs from the  $\lambda_{\max}$  of the detection signal (see column 2, lines 16-21, column 9, lines 22-29).

All features of claim 20 are disclosed in D7, therefore the subject-matter of claim 20 is not new (Article 33(2) PCT).

Additional feature of claim 21 is also disclosed in D7.

## 3.

The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 1-14, 22 does not involve an inventive step in the sense of Article 33(3) PCT.

### 3.1

Document D5 describes a detection system comprising organic light emitting diodes, having at least one organic semi-conductive electroluminescent active layer (column 2, lines 18-67, column 9, lines 63-66), and emitting different wavelengths.

The subject-matter of claim 1 differs from D5, in that a diode has an active layer comprising at least two different electroluminescent functionalities, and the emission spectrum of the diode exhibits at least two intensity maxima.

The problem to be solved by these technical features can therefore be interpreted as to simplify the manufacturing of a detecting system requiring multiwavelengths sources.

This problem and its solution are however known in the prior art for detecting systems using III-V semiconductor compounds light emitting devices (See D7, column 2, lines 14-30), which are known as alternatives to detecting systems using OLED (see D5, column 1). The solution proposed in this document implies the use of a single light emitting structure producing different wavelengths and more particularly a structure producing two different wavelengths under positive or negative bias.

Therefore it would be obvious for the skilled person faced with the problem mentioned above to apply the solution as described in D7 to the detecting system as described in D5 by using an OLED structure emitting different wavelengths and in particular two different wavelengths under positive and negative applied bias (structure known in the field of OLEDs, see D8, figure 3, column 2, lines 22-29, column 1, lines 45-52).

Consequently the subject-matter of claim 1 does not involve an inventive step in the sense of Article 33(3) PCT.

### 3.3

Dependent claims 2-14 and 22 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step, as features of claims 2-12, 14 refer to compounds and characteristics used for an OLED emitting different wavelengths (see D8, columns 4, 7), the subject-matter of claim 13 is mentioned in D5 (column 6, the substrate can comprise a color filter, whose function is to select one maxima of the spectrum corresponding to a particular color and to have a reduced transmission for the other wavelengths, so at least those situated between two maxima) and it would be obvious for the skilled person to use, in accordance with circumstances, a single organic light source in a detection system, generating a reference signal and a detection signal, as an alternative to a single inorganic light source as described in D7 (claim 22).

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New Claims

(65)

1. A detection system comprising a light emitting diode (LED) having at least one (semi)conductive electroluminescent active layer which comprises at least two different electroluminescent functionalities, wherein the emission spectrum of the diode exhibits at least two intensity maxima and wherein the active layer comprises at least one electroluminescent organic compound.
2. A detection system according to claim 1, wherein the LED comprises an electroluminescent compound selected from the group consisting of electroluminescent polymers, electroluminescent oligomeric dyes and electroluminescent single dyes.
3. A detection system according to claim 2, wherein the LED comprises an electroluminescent polymer and an electroluminescent single dye.
4. A detection system according to any one of the preceding claims, wherein two different electroluminescent functionalities are formed by a first and a second electroluminescent compound, wherein the first compound has a maximum in the emission spectrum at a different wavelength than the second compound.
5. A detection system according to any one of the preceding claims, wherein at least two different electroluminescent functionalities form part of one electroluminescent compound.
6. A detection system according to claim 5, wherein the compound is selected from the group consisting of copolymers having at least two different electroluminescent segments, electroluminescent polymers derivatized with at least one electroluminescent dye, and non-electroluminescent compounds, preferably polymers, derivatized with at least two different electroluminescent dyes.

7. A detection system according to any one of the preceding claims, wherein at least one electroluminescent compound is selected from the group consisting of poly(paraphenylene vinylene) compounds, polyfluorene compounds, copolymers of said polymers and said polymers derivatized with one or more of said dyes.
8. A detection system according to claims 1-7, wherein the emission spectrum of the LED is bimodal.
9. A detection system according to claims 1-8, wherein the difference in wavelength between two consecutive maxima in the emission spectrum of the LED is at least 40 nm.
10. A detection system according to any one of the preceding claims, wherein the LED's emission spectrum has at least one maximum, preferably at least two maxima, in the wavelength range of 190-1500 nm, preferably of 400-800 nm.
11. A detection system according to any one of the preceding claims, wherein the intensity ratio between two consecutive maxima in the emission spectrum is in the range of 0.5 to 1.
12. A detection system according to any one of the preceding claims, wherein in the emission spectrum the peak to valley ratio of the first and the second maximum is at least 2, preferably at least 10.
13. A detection system according to any one of the preceding claims, wherein the LED comprises a filter, preferably a filter with notch filter properties, which filter selectively has at least a reduced transmission of light of a wavelength between two consecutive intensity maxima.
14. A detection system according to any one of the preceding claims wherein the LED, depending on the direction of the electric current through the active layer, emits light having a first intensity maximum or, conversely, light having a second intensity maximum, different from the first intensity maximum.
15. A light emitting diode having at least one (semi)conductive electroluminescent active layer which comprises at least two different

electroluminescent functionalities, wherein the emission spectrum of the diode exhibits at least two intensity maxima, wherein the LED comprises an electroluminescent polymer and an electroluminescent single dye.

16. A light emitting diode having at least one (semi)conductive  
5 electroluminescent active layer which comprises at least two different electroluminescent functionalities, wherein the emission spectrum of the diode exhibits at least two intensity maxima, wherein the LED comprises a polyfluorene, which may be a polyfluorene copolymer and/or a polyfluorene derivatised with an electroluminescent dye.
- 10 17 A light emitting diode having at least one (semi)conductive electroluminescent active layer which comprises at least two different electroluminescent functionalities, wherein the emission spectrum of the diode exhibits at least two intensity maxima, wherein the LED comprises a filter,  
preferably a filter with notch filter properties, which filter selectively has at  
15 least a reduced transmission of light of a wavelength between two consecutive intensity maxima.
18. A method for manufacturing a light emitting diode according to any one of the claims 15-17, wherein at least one active layer, which comprises at least one electroluminescent compound as defined in any one of claims 1-13, is  
20 applied to an electrode.
19. A method according to claim 18, wherein the light emitting diode is applied by means of spin coating or printing.
20. Use of a single light source, preferably a light emitting diode, for generating a reference signal and a detection signal in a detection system,  
25 wherein the  $\lambda_{\max}$  of the reference signal differs from the  $\lambda_{\max}$  of the detection signal.
21. Use according to claim 20, wherein detection signal and reference signal are both directed at a composition to be analyzed.
22. Use according to claim 20 or 21, wherein the light source is a light  
30 emitting diode as defined in any one of claims 1-17.